The Invention

The present invention resides in a method for validating that a sensor array detection ability mimics a human nose detection ability, in that two odorants at constant fractions of their particular vapor pressures will elicit the same response in an electronic nose as in a human nose.

Rejection under 35 U.S.C. § 103(a) over Gross *et al.*

The Examiner has rejected claims 9 and 17 under 35 U.S.C. § 103(a) as allegedly being obvious over Gross *et al.*, U.S. Patent No. 5,761,090. In response, Applicants respectfully traverse the rejection.

Gross *et al.* recite methods for testing industrial processes and determining sensor status. As the Examiner points out, the claims of Gross *et al.* recite the steps of:

> operating at least a first and second sensor to form at least one sensor pair to redundantly detect at least one **physical variable** of the industrial process to provide a first signal from said first sensor and a second signal from said second sensor, each said signal being characteristic of the one physical variable. (Emphasis added).

The Examiner considers "the matching of the data of the signal to proper response of the sensor as recited by Gross to be a teaching of validating the sensor response as able to mimic the human nose."

However, Gross *et al.* define the stimulus to the sensor as a "physical variable", which is defined at column 2, lines 14-15 of the specification to be "temperature, pressure, radiation level, vibration level, etc." Preferred stimuli are exemplified at column 14, line 53, and include "steam temperature and steam pressure," and at lines 57-58, "coolant flowrate." These are the preferred stimuli that the methods and sensors of Gross *et al.* are detecting and measuring. Steam temperature and pressure are not odorants as are presently taught and claimed.

In stark contrast to the teaching of Gross *et al.*, the preferred stimuli for the methods and sensors of the present invention are odorants: organic molecules and

PATENT

living organisms. As set forth in the specification at page 9, lines 11-15 of the present application, odorants include, but are not limited to:

> alkanes, alkenes, alkynes, dienes, alicyclic hydrocarbons, arenes, alcohols, ethers, ketones, aldehydes, carbonyls, carbanions, heterocycles, polynuclear aromatics, organic derivatives, biomolecules, microorganisms, bacteria, viruses, sugars, nucleic acids, proteins, isoprenes, isoprenoids, fatty acids and their derivatives.

Applicants submit that there is no motivation or suggestion to start with mechanical stimuli such as temperature, pressure, vibration, etc., and arrive at stimuli such as organic molecules and living organisms.

Moreover, the Examiner's attention is respectfully directed to page 13, line 28 to the top of page 14, line 3, of the specification sets for the following:

> A first odorant is pentane and a second odorant is tetradecane. The vapor pressure of pentane is 46 torr in 707 torr of air. The vapor pressure of tetradecane is 8.5×10^{-4} torr in 707 torr of air. Stimulated with these two compounds, the electronic nose produced nearly the same odor intensity from the raw signal outputs for $P=0.1 \bullet P^0$ of pentane ($P=46$ torr in 707 torr of air = 61,000 parts per million) as they did for $P=0.1 \bullet P^0$ of tetradecane ($P=8.5 \bullet 10^{-4}$ torr in 707 torr air = 1.1 parts per million). In this example, the sensor array intensity validly matches the intensity response of that of a human nose because 10% of the vapor pressure of the first odorant has the same response intensity as 10% of the vapor pressure of the second odorant. This is demonstrated graphically in Figure 1b for n-pentane (at 46 torr), n-nonane (at 0.37 torr) and n-tetradecane (at $8.5 \text{-} 10^{-4}$ torr), wherein the odorant partial pressures correspond to 10% of their vapor pressures in ambient air.

These odorant all exhibit a sensor response of the same magnitude, successfully mimicking the response of the human nose. Prior to the advent of the present invention, it was not known that an electronic nose responded in the same manner as a human nose in that odorants with lower vapor pressures elicit greater responses, and therefore have lower mean detection thresholds. As described in the specification, Applicants have found that an electronic nose, like a human nose, produces higher

response intensities for odorants with low vapor pressures and lower response intensities for odorants with high vapor pressures.

By determining whether a particular sensor arrays behaves in a manner similar to human noses, *i.e.*, the methods set forth herein, the present invention provides an important tool for establishing the importance of the use of sensor arrays for odorant detection. In fact, the Examiner admits in a further rejection that "Gross does not teach the interrogation of a sensor with the particular physical elements as claimed by applicant."

Accordingly, Applicants submit that the present invention is not obvious in view of Gross *et al.*, and respectfully request that the rejection be withdrawn.

Rejection under 35 U.S.C. § 103(a) over Gross *et al.* in view of Lewis *et al.*

The Examiner has further rejected claims 10-15 under 35 U.S.C. § 103(a) as allegedly being obvious over Gross *et al.* in view of Lewis *et al.* (U.S. Patent No. 5,571,401). The Examiner alleges that it would be obvious to combine the method of testing and determining the status of a sensor in an industrial process, as taught by Gross *et al.*, with the sensor of Lewis *et al.* to arrive at the instant invention. In response, Applicants respectfully traverse the rejection.

As discussed above, the stimuli that the methods of Gross *et al.* are sensing are mechanical in nature. The sensors of Lewis *et al.*, however, rely on chemical stimuli such as those discussed above.

In addition, the methods of Gross *et al.* are for use in for example, a nuclear reactor coolant pump, delayed neutron monitoring systems, and turbines, as set forth at column 7, lines 9-12, and column 14, line 52. In stark contrast to Gross *et al.*, the commercial applications of the sensors for arrays and noses of Lewis *et al.* include environmental toxicology and remediation, biomedicine, materials quality control, food and agricultural products monitoring, etc. In view of the radically different types of stimuli, as well as the dissimilar industrial applications of Gross *et al.* and Lewis *et al.*, Applicants submit that there is no suggestion or motivation to combine the two patents to

PATENT

arrive at the present invention. Given the radically different fields that Gross *et al.* and Lewis *et al.* operate in, Applicants submit that there is no reasonable expectation of success to combine Gross *et al.* and Lewis *et al.* to arrive at the present invention. In addition, neither reference teaches or suggests a sensor array using the method of the present invention. Accordingly, Applicants respectfully request that the rejection be withdrawn.

CONCLUSION

In view of the foregoing, Applicants believe all claims now pending in this Application are in condition for allowance. The issuance of a formal Notice of Allowance at an early date is respectfully requested.

If the Examiner believes a telephone conference would expedite prosecution of this application, please telephone the undersigned at 925-472-5000.

Respectfully submitted,

Joseph R. Snyder
Reg. No. 39,381

TOWNSEND and TOWNSEND and CREW LLP
Two Embarcadero Center, 8th Floor
San Francisco, California 94111-3834
Tel: 925-472-5000
Fax: 415-576-0300
JS:js
WC 9051248 v1

VERSION WITH MARKINGS TO SHOW CHANGES MADE

Please enter new claims 19 and 20.

PENDING CLAIMS

9. (Amended) A method for validating that a sensor array detection ability mimics a human nose detection ability, the method comprising:

(a) contacting said sensor array with a constant fraction of a known vapor pressure of a first odorant to produce a first response intensity;

(b) contacting said sensor array with a constant fraction of a known vapor pressure of a second odorant to produce a second response intensity;

(c) comparing said first response intensity to said second response intensity; and

(d) determining whether said response intensities are similar, thereby validating that said sensor array response detection ability mimics said human nose detection ability.

10. A method in accordance with claim 9, wherein said sensor array comprises at least two sorption-based sensors which are members selected from the group consisting of a chemiresistors, a conducting/nonconducting regions sensor, a SAW sensor, a metal oxide gas sensor, a bulk conducting polymer sensor, a Langmuir-Blodgett film sensor, and combinations thereof.

11. A method in accordance with claim 10, wherein said sensor is a conducting/nonconducting regions sensor.

12. A method in accordance with claim 10, wherein said sensor is a bulk conducting polymer sensor.

13. A method in accordance with claim 11, wherein said nonconducting region is an organic polymer.

14. A method in accordance with claim 13, wherein said organic polymer is a member selected from the group consisting of (poly(4-vinyl phenol), poly(α-methyl styrene), poly(vinyl acetate), poly(sulfone), poly(caprolactone), poly(ethylene-co-vinyl acetate), poly(ethylene oxide), poly(ethylene), poly(butadiene), poly(vinylidine fluoride), poly(n-butyl methacrylate), poly(epichlorohydrin) and poly(ethylene glycol)).

15. A method in accordance with claim 9, wherein said odorant is a member selected from the group consisting of alkanes, alkenes, alkynes, dienes, alicyclic hydrocarbons, arenes, alcohols, ethers, ketones, aldehydes, carbonyls, carbanions, heterocycles, polynuclear aromatics, organic derivatives, biomolecules, microorganisms, bacteria, viruses, sugars, nucleic acids, isoprenes, isoprenoids, fatty acids and their derivatives.

17. A method for validating that a sensor array detection ability mimics a human nose detection ability, the method comprising:

(a) contacting said sensor array with a first odorant with a first vapor pressure to produce a first response intensity;

(b) contacting said sensor array with a second odorant with a vapor pressure lower than said first vapor pressure to produce a second response intensity;

(c) comparing said first response intensity to said second response intensity; and

(d) determining whether said second response intensity is greater than said first response intensity, thereby validating that a sensor array detection ability mimics a human nose detection ability.

18. The method of claim 9, wherein said constant fraction is 10%.

19. (New) A method for validating that a sensor array detection ability mimics a human nose detection ability, the method comprising:

(a) contacting said sensor array with a 10% fraction of a known vapor pressure of a first odorant to produce a first response intensity;

(b) contacting said sensor array with a 10% constant fraction of a known vapor pressure of a second odorant to produce a second response intensity;

(c) comparing said first response intensity to said second response intensity; and

(d) determining whether said response intensities are similar, thereby validating that said sensor array response detection ability mimics said human nose detection ability.

20. (New) A method in accordance with claim 19, wherein said sensor array comprises at least two sorption-based sensors which are members selected from the group consisting of a chemiresistors, a conducting/nonconducting regions sensor, a SAW sensor, a metal oxide gas sensor, a bulk conducting polymer sensor, a Langmuir-Blodgett film sensor, and combinations thereof.